

Energy efficient lighting – a guide for installers



- Low energy lighting for domestic and multi-residential buildings
- Internal and external applications
- Lifetime savings of approximately £54 per lamp over comparable GLS lamps
- Lighting design and controls can make further savings



ENERGY EFFICIENCY

**BEST PRACTICE
PROGRAMME**

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1 INTRODUCTION

INTRODUCTION

The electrical installation contractor holds the key to substantial energy savings in housing and multi-residential dwellings. The contractor can advise and influence the client's decision to install energy efficient lighting.

The purpose of this Guide is to inform electrical contractors of the size of this important market and the energy savings achievable. The Guide offers advice to electrical contractors on the use of available energy efficient lighting technologies and helps them present the case to clients.

It has been produced by BRECSU on behalf of the Department of the Environment (DOE) with the collaboration of the Electrical Contractors' Association and the Lighting Industry Federation (see back cover for addresses).

A number of technical terms are used in this Guide. Terms that appear in **bold** type are explained in more detail in the glossary on page 15.

There are a number of ways in which the contractor can reduce the energy demand for lighting:

- using energy efficient lamps and **luminaires** (light fittings)
- directing light where needed (task-directed lighting)
- controlling the use of light
- making the most of daylight.

Lighting accounts for significant electrical consumption in residential buildings. Figures suggest that each year in the UK 900 000 existing and new dwellings have major electrical wiring work carried out in them. If all were fitted with energy efficient lighting today, the energy savings would be equivalent to about 2×10^8 kWh, or £14.76 million, per year. These savings would continue, and accumulate each year, as illustrated in figure 1. If installation work were to continue at the same rate (ie installing energy efficient lighting in 900 000 dwellings each year), then at the end of 10 years a total of 110×10^8 kWh (39 600 kGJ) would be saved (equivalent to £811.8 million).

There are also good environmental reasons why energy for lighting should be saved. Lighting consumes electricity, which is generated in the UK mainly by fossil fuel fired power stations, coal fired in particular, releasing significant amounts of carbon dioxide (a greenhouse gas) into the atmosphere. The total potential for savings is equivalent to over 125 000 tonnes of carbon dioxide per year.

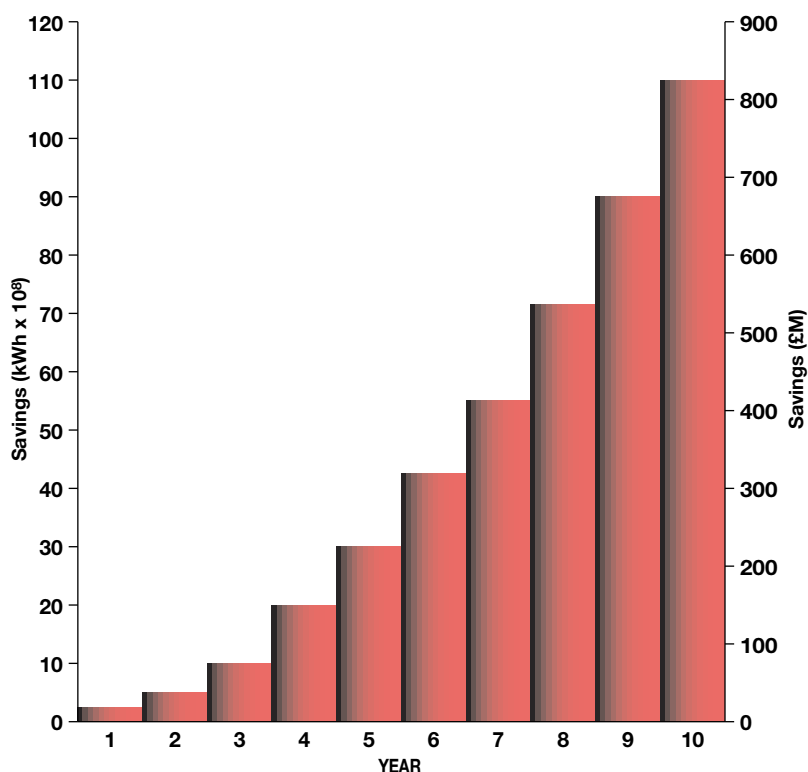


Figure 1 Illustrating cumulative energy and cost savings over ten years

2 LIGHT SOURCES

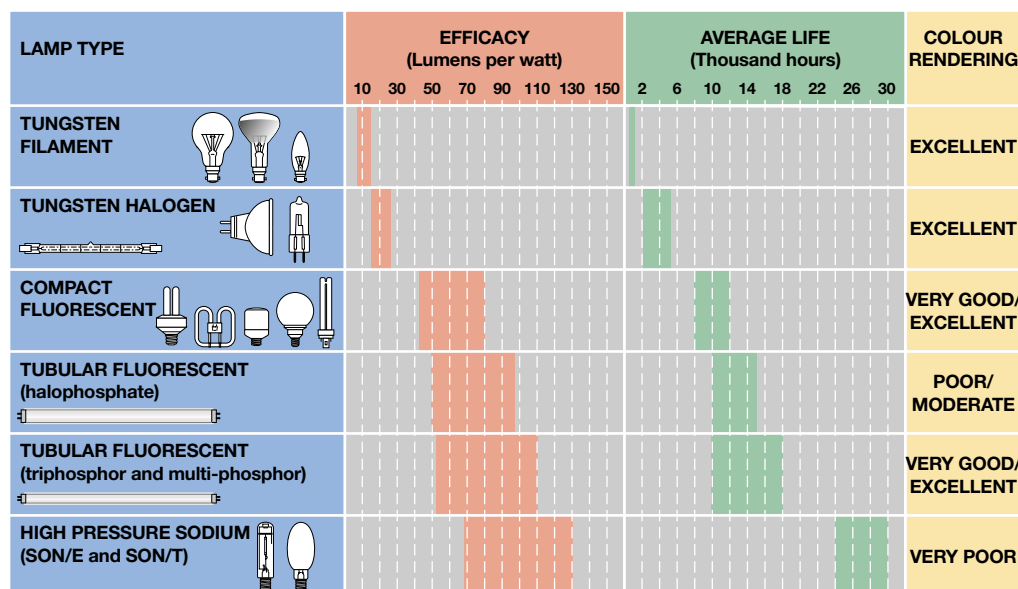


Figure 2 Performance characteristics for a range of lamp types

TYPES OF LIGHT SOURCE

Figure 2 compares the performance characteristics of lamp types likely to be used in or around houses and multi-residential buildings.

The term efficiency can only be used when comparing two quantities of the same unit eg, watts output to watts input. It is incorrect to measure light in watts so the measure of how effective an electric lamp is in generating luminous flux (quantity of light) is called **efficacy**. Lamp **luminous efficacy** is the ratio of the **lumens** emitted by the lamp to the power consumed by the lamp (watts) and is expressed as lumens per watt (l/W). The efficacy of the lamps in figure 2 is based on the lumen output (when the lamp is new) and the power taken by the lamp only, but includes the power taken by the ballast where the ballast is built into the lamp. The efficacy is shown as bands because luminous efficacy of lamp types varies depending upon such factors as wattage, operating voltage, operating frequency, current density or pressure within the discharge tube, and type of phosphor coating.

Lamp life is a difficult subject and sometimes dissimilar criteria are used to evaluate the life of different lamp types. **Average lamp life**, that is when 50% of a sample batch of lamps fail under test conditions, is used for all the lamps referenced in this diagram. The average life of the lamp types is shown as bands because the average life of lamps

within the same type varies, depending upon such factors as wattage, operating voltage, and type of **ballast**. Switching can have a marked effect on life, particularly of fluorescent lamps, with many switching operations reducing it.

Colour rendering is an expression of how accurately coloured surfaces appear under different sources of light and may be denoted by a colour rendering index (R_a) up to 100 (figure 3, column 1). The higher the number the better the colour rendering.

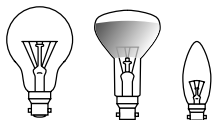
Alternatively, a colour rendering class may be used. Both systems are used (figure 3, column 2) by manufacturers to denote this lamp property. Because of the importance of colour in the home, it is advisable to use class 1A or 1B lamps in most domestic interiors.

Colour rendering index (R_a)	Class	Description*
90-100	1A	Excellent
80-89	1B	Very good
60-79	2	Moderate
40-59	3	Poor
20-39	4	Very poor

*CIBSE Interior Lighting Code, 1994

Figure 3 Types of lamps and their performance (lamps with R_a of 80 and above should be used in the home)

LIGHT SOURCES



Incandescent tungsten filament lamps

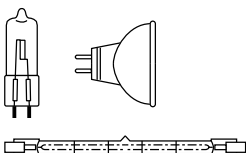
The most common types are known as general lighting service (GLS) lamps and decorative (eg candle) lamps. The majority of luminaires (light fittings) in most homes use incandescent tungsten filament lamps with an efficacy of only about 8 to 15 l/W. Incandescence literally means light produced from heating, achieved by passing an electrical current through a strand of tungsten filament. The filament is delicate and eventually burns out after about 1000 hours. Although some lamps are made to last longer and sold as double life lamps, this is at the cost of light output.

Advantages:

- low purchase price
- excellent colour rendering
- no ballast required
- immediate full light when switched on
- ease of dimming
- sparkle lighting effects can be created
- operates in any plane (universal operating position).

Disadvantages:

- low efficacy – 8 to 15 l/W
- short life, usually 1000 hours
- high running cost.



Tungsten halogen (quartz halogen) lamps

These are versions of the tungsten filament lamp. Many tungsten halogen lamps operate at 12 volts, (**extra low voltage – ELV**) requiring a transformer that is now quite neat and small. This light source is compact and can be focused and directed better than any other, making it particularly appropriate for spotlighting. Although they should not be regarded as having high efficacy, tungsten halogen lamps

produce 16 to 25 lumens per watt and last longer than standard tungsten filament lamps. Mains voltage tungsten halogen lamps can be dimmed with a simple domestic dimmer of the right capacity, but some ELV lamps may require a special dimmer depending upon the type of transformer used. Running the lamp at lower than the rated voltage will lower the filament operating temperature, preventing the halogen cycle* from taking place, and causing the lamp to blacken. The blackening can be removed by occasionally running the lamp at full light output. The quartz lamp envelope should not be handled with bare hands and manufacturers instructions regarding the operating position of the lamp should be observed.

Advantages:

- higher efficacy than conventional tungsten filament lamps
- brighter, whiter light
- life of 2000 to 5000 hours depending on type
- excellent colour rendering
- no ballast required
- immediate full light output when switched on
- can be dimmed
- bulb blackening eliminated when run at full light output.

Disadvantages:

- transformer required for extra low voltage lamps
- requires careful handling
- operating positions of double ended types is limited to horizontal.

** On heating up, the filament gives off tungsten which combines with the halogen gas. This tungsten is redeposited on the filament on cooling down (when the lamp is switched off).*

Ultraviolet radiation

Some people are concerned about ultraviolet radiation from electric lamps. It is, in fact, considerably less than would be experienced outdoors. Ultraviolet (UV) is the same type of radiation as light, and differs only in being at shorter wavelengths. Lamps for **general lighting** purposes emit some UV. Under typical indoor lighting the irradiation from bare fluorescent lamps will be 0.35% of the UV irradiation received under typical daylight. Unshielded tungsten halogen lamps emit a small proportion of ultraviolet and when used for lighting sensitive materials, or when used at close range for task lighting, an ultraviolet filter should be fitted. Reflector lamps with front glasses and the new 'UV stop' lamps will normally not need to be shielded. For specific guidance refer to lamp manufacturers.

LIGHT SOURCES

**Tubular fluorescent lamps**

Fluorescent lamps have four to ten times the efficacy of incandescent lamps and can last up to eighteen times longer, depending on the type of lamp and its ballast. All fluorescent lamps require a ballast to operate.

Fluorescent lamps and tungsten filament lamps work in entirely different ways. The fluorescent tube contains an inert gas, usually argon or krypton at low pressure, and a small amount of mercury. When an arc is struck between the lamp's electrodes, ultraviolet radiation is produced, which excites a phosphor coating on the inside of the tube to produce light at visible wavelengths.

The quality of light that is produced depends on the precise mix of phosphors in the coating. Older halophosphate phosphors decayed noticeably over the life of the lamp, but the newer triphosphor and multi-phosphor lamps lose less light output. The latest triphosphor lamps maintain most of their initial light output throughout their life.

Older tubular lamps 600 mm long and over were usually 38 mm diameter (known as T12) but newer lamps are 26 mm diameter (known as T8). Simply by replacing T12 by T8 lamps in switch-start luminaires will save up to 10% energy.

Advantages:

- low running cost
- high efficacy
- very good to excellent colour rendering
- long life in normal use
- minimal reduction of light output through life
- prompt start and restart
- quick run-up to full light output
- up to 10% energy saving when replacing equivalent T12 on switch-start circuits
- universal operating position.

Disadvantages:

- excessive switching shortens life
- ballast required
- can be dimmed but requires special ballast and dimmer.

High pressure sodium SON/E and SON/T lamps

Although not regarded as domestic lamps, high pressure sodium **discharge lamps** combine high efficacy with very long life and are particularly suited for floodlighting and illuminating larger exterior areas that need to be lit for long periods. They are not made for frequent switching and therefore should not be operated by presence detectors for security lighting.

Advantages:

- very low running cost
- very high efficacy
- very long life
- quick start
- universal operating position.

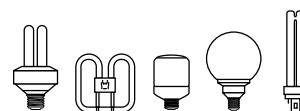
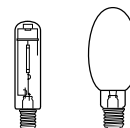
Disadvantages:

- high purchase cost
- very poor colour rendering
- ballast required
- requires 1.5 to 6 minutes time to run up to full output
- delayed restart when hot on most lamps.

Compact fluorescent lamps (CFLs)

New technology has reduced the size of fluorescent tubes, and compact fluorescent lamps have been developed to replace tungsten filament lamp applications in the home. These new lamps give a light similar to tungsten lamps and present a good opportunity to light homes with a fifth of the energy required before. Although they cost more to purchase than traditional GLS lamps (bulbs), CFLs make savings in the electricity bill straight away. CFLs should be installed in fittings that are heavily used (>4hrs/day), for example in living areas and circulation areas, halls, stairways, landings, common passages outside buildings and areas that are likely to be lit continually.

Virtually all tungsten lamps can be replaced with compact fluorescents as the opportunity arises, except in some luminaires which use crystal glass to create sparkle. An ever growing range of compact lamps is available in various wattages, shapes and sizes. Many of these lamps have a ballast built in, or an adapter enabling them to fit



LIGHT SOURCES

directly into the standard bayonet cap (BC) or Edison screw (ES) lamp-holders. CFLs generally have five times the efficacy and last eight to twelve times longer than a tungsten lamp of equivalent light output. When cold, CFLs produce 40 to 60% of their full light output which is reached after about two minutes. CFLs should not be used with the standard domestic dimmer control but it is possible to dim the separately ballasted four contact versions of the lamps with a dimmable ballast and compatible dimming equipment.

Advantages:

- low running cost
- replacement for tungsten lamps
- five times the efficacy of equivalent tungsten lamps
- average life of 8000 to 12 000 hours
- very good colour rendering with most lamps and some types giving excellent colour rendering
- quick run up to full light output
- prompt start and restart
- four pin lamps can be dimmed with suitable ballast and dimmer
- universal operating position but light output may be reduced with some types.

Disadvantages:

- excessive switching shortens life
- ballast required but is built in on some lamps
- not suitable for use on standard domestic dimmer.

Cost comparison: CFLs vs GLS

The time taken (T) to recover the extra cost of replacing a tungsten lamp with a more efficient lamp of equivalent light output can be calculated as follows:

$$T = \frac{1000 Pr}{Pt + E (Wt - Wr)}$$

Pr = Price of replacement lamp

Pt = Price of tungsten lamp

E = Electricity cost in £/kWh

Wt = Wattage of tungsten lamp

Wr = Wattage of replacement lamp including ballast losses

Therefore, the time taken to recover the extra cost of replacing a 100 W tungsten lamp with a 20 W electronic ballasted CFL priced £9.99 is 1560 hours (equal to about 4.25 hours use each evening for a year), using the assumptions given in figure 4.

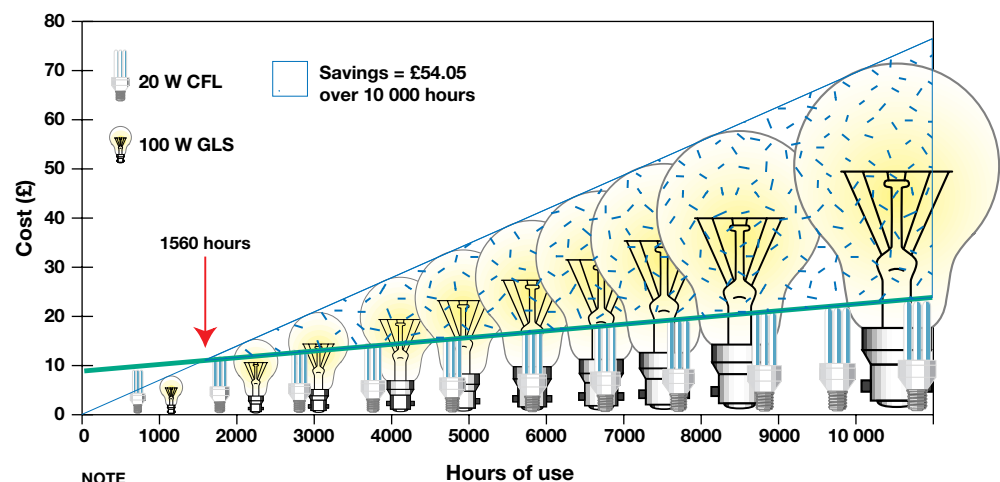
Figure 4 compares the running costs of 100 W tungsten lamps and 20 W CFLs over 10 000 hours.

When: Pr = £9.99 Pt = £0.50 E = £0.0738

Wt = 100W Wr = 20

The savings over 10 000 hours are

£78.80 – £24.75 = £54.05.



NOTE

100 W tungsten filament lamp (GLS) initial output 1330 lumens, cost £0.50, life 1000 hours

20 W compact fluorescent lamp (CFL) initial output 1200 lumens, cost £9.99, life 10 000 hours

Cost of electricity £0.0738 per unit (kWh)

Figure 4 Cost of buying and using GLS vs compact fluorescent lamps

3 LAMP BALLASTS

LAMP BALLASTS

All discharge lamps including fluorescents require a ballast. The type of ballast will greatly affect the **connected load**. Unlike most electrical products, luminaires for discharge lamps, including fluorescents, are not labelled with their connected load, but by the nominal wattage of the lamp which should be installed. The additional ballast load should, therefore, always be taken into account when calculating the connected load. The ballast creates the right conditions to start the discharge and to regulate the voltage and current. Each different model of lamp requires a different electrical input and hence requires a ballast specifically designed to drive it.

The wire wound core-coil ballast, sometimes called a **choke**, which has been the standard since fluorescent lighting was first developed, uses electromagnetic technology. A phase shift is created between the current and voltage causing poor **power factor** which is corrected by placing a capacitor in the circuit. The all-in-one **high frequency electronic ballast** unit, available mainly for fluorescent lamps, uses solid-state technology and operates at near unity power factor. All ballasts consume electricity: high frequency electronic ballasts consume less than wire wound equivalents.

High frequency electronic ballasts may be rapid-start for instantaneous light, or soft-start in which there is a moment's delay.

Frequently switched lamps should be connected to a soft-start ballast to prolong lamp life. Some high frequency electronic ballasts respond to an external signal enabling the light output to be varied. These are sometimes called dimming, regulating, or variable output ballasts and can provide a means of reducing energy when maximum **illuminance** is not required, since energy used correlates closely to light output over most of the dimming range.

High frequency electronic ballasts run the lamp at frequencies between 20 to 40 kHz and:

- consume up to 30% less circuit power than a wire wound ballast for a given light output
- are lighter in weight than their wire wound equivalents
- are silent in operation.

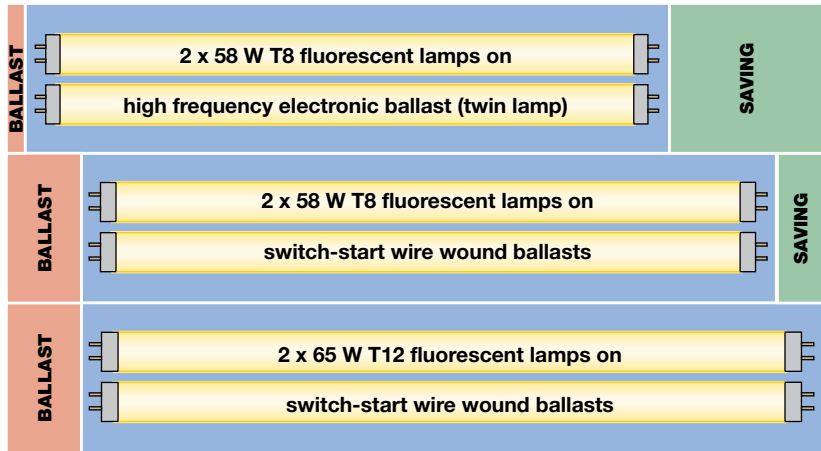
There are a number of other advantages of high frequency electronic ballasts.

- Lamps start at the first attempt without annoying flashing.
- Lamps last longer.
- The quality of light is improved with the elimination of flicker and stroboscopic effects.
- There is automatic switch off at the end of life, eliminating any lamp flashing.
- The lamp can often be operated at less than its nominal wattage.
- Lamps are over-voltage protected.

Figure 5 shows the connected load and therefore energy savings to be achieved by replacing two 1500 mm long T12 lamps with T8 lamps on switch-start wire wound ballasts and then replacing those ballasts by a twin lamp high frequency electronic ballast.

Due to space limitations CFLs with inbuilt and adaptor ballasts are not fitted with power factor correcting capacitors and may have a power factor as low as 0.5. Since the domestic user pays for electricity measured by a kWh meter there is no cost penalty to the consumer, and although there is some waste of the power generated, it is still possible to make significant energy savings over tungsten filament lamps. Where such lamps are a small part of the total electrical load this is not a problem and luminaires for separately ballasted lamps are usually fitted with power factor correcting capacitors.

Figure 5 Load savings based on two 1500 mm long fluorescent tubular lamps and ballasts



0 Connected load (W) 160
NOTE Lamps operate at 50 W on high frequency electronic ballasts

LAMP BALLASTS

Installation and service guidance when using high frequency (HF) electronic fluorescent lamp ballasts

The following matters are of particular relevance to electrical contractors when using HF electronic ballasts.

■ **Installation insulation resistance testing**

In common with other electronic products, electronic ballasts should not be subjected to the insulation resistance tasks*.

■ **Residual current devices (RCDs)**

As a general rule, the earth leakage current may be assumed to be not more than 1 mA per twin luminaire.

■ **Miniature circuit breakers (MCBs)**

The number of HF electronic ballasts which may be operated in a circuit protected by a given MCB may vary with ballast design. Installers should refer to the manufacturer's information for guidance.

■ **Starting aid**

A few HF electronic ballasts require a lamp starting aid for satisfactory operation. This will normally be in the form of an earthed metal plate electrically connected to the ballast (eg part of a luminaire) at a maximum distance of 15 mm from the lamp wall, and extending along the whole of its length. (In most luminaires this is provided by the manufacturer.)

■ **Master/slave operation**

It is generally not considered to be best practice, nor recommended for all ballasts, for two single lamp luminaires to be installed with a twin lamp HF electronic ballast in one luminaire only.

■ **The use of mineral insulated cables (MICC)**

MICC or similar construction cables cannot be used for HF electronic ballast to lamp connections.

■ **Internal cables**

To minimise radio-frequency interference unscreened supply cables within luminaires must not run adjacent to leads connected to the ballast output terminals and where crossing is necessary, this should be arranged at right angles.

■ **External supply and control cables**

Where low voltage (supply) cables run adjacent to extra low voltage (control) cables, the level of insulation should be the same for both, ie at the higher level.

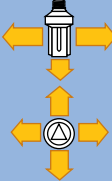
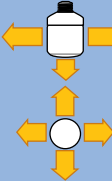
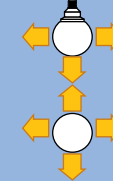
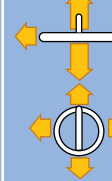
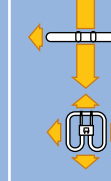








■ **Retrofit precautions**

The mixing of HF magnetic and electronic ballasts on the same circuit is not recommended without prior consultation with the manufacturers.

* The ECA advice for the installation of HF luminaires states that an insulation test on lighting circuits with luminaires should not be carried out unless L+N are linked within each luminaire for the period of the test. Do not exceed a time duration of 2 seconds or exceed 500 volts. The measurement is then made between the linked L/N to earth

For further information refer to manufacturer's guidance notes

4 LUMINAIRES FOR CFLs

CFL						
Luminaire						
	TRANSLUCENT SHADE	✓	✓		✓	✓
	OPAQUE SHADE			✓	✓	✓
	TRANSLUCENT CYLINDER	✓				✓
	TRANSLUCENT DRUM	✓			✓	✓
	TRANSLUCENT SPHERE	✓				
	WALL UPLIGHTER	✓				✓
	PENDANT/FREE STANDING UPLIGHTER				✓	✓
	LAMP-HOLDER		✓	✓		

LUMINAIRES (LIGHT FITTINGS)

When converting from tungsten it is essential to make sure that the replacement compact fluorescent lamp will fit into the luminaire and to choose the correct type. For example, lamps emitting most of their light sideways should not be placed in shades designed to allow light up and down. Several types of CFLs have the equivalent light output to a tungsten lamp but distribute the light in different ways, roughly proportional to their projected area. By looking at the lamp from several angles, it is possible to estimate how much light is emitted in different directions. The largest area of the lamp you can see will be where most of the light is directed.

Lighting equipment comprises lamp, ballast if needed, and luminaire. Each element contributes to the overall efficiency. There is no sense in placing an efficient lamp in an inefficient luminaire, so always use the one which is most efficient.

A good guide to luminaire efficiency is the **light output ratio** quoted by manufacturers, ie the light output of the luminaire divided by the light output of the lamp or lamps inside the luminaire. For example in an opal **diffuser** luminaire with a light output ratio of 0.5, half the light given out by the lamp(s) is lost inside the luminaire.

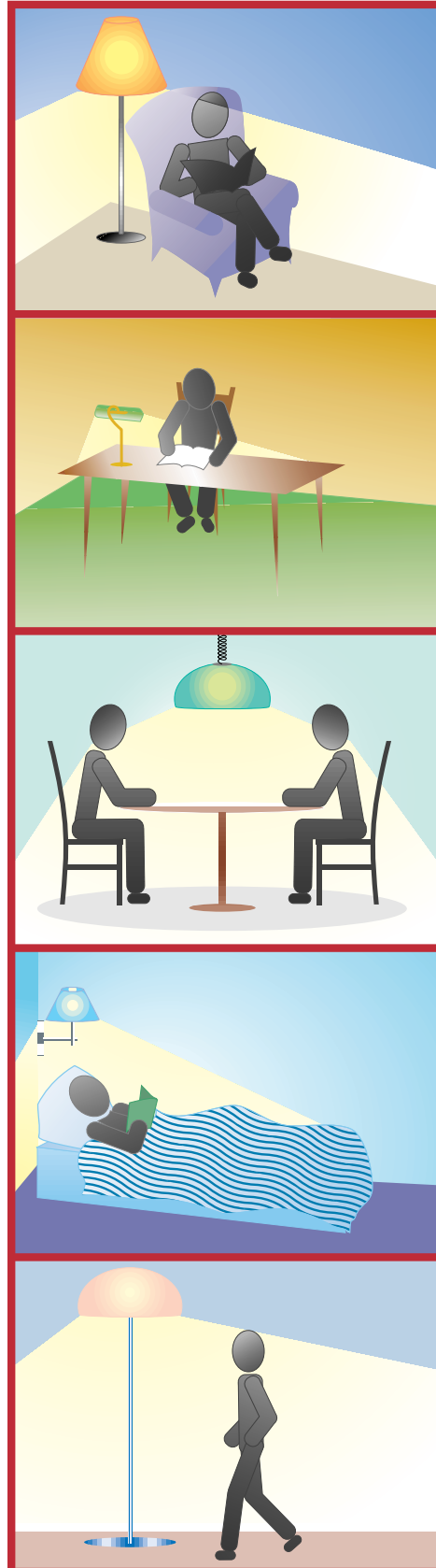
Improvements in luminaire design and materials mean that greater efficiency for a given light distribution is now possible. Always use the most efficient luminaire to achieve the desired lighting.

Figure 6 is a guide to light distribution from CFLs and which to use in common luminaires. The relative size of the arrows indicate the proportion of light in that direction and the ticks suggest the best lamp types for a particular style of luminaire.

Figure 6 A guide to light distribution from CFLs and which to use in common luminaires

5 LIGHTING DESIGN

Figure 7 Directing light where it is required reduces the waste of energy



LIGHTING DESIGN

There are three different types of lighting that are referred to by lighting designers:

- general – eg a central hanging light
- task lighting – eg a desk or table lamp
- atmospheric or ornamental – eg a spotlight on a picture.

Here are a few guidelines that can help with getting your lighting right.

- Decide what the lighting is really needed for – then design your lighting scheme to position lights where they will be used. Use task lighting. Provide sockets for reading lamps.
- Use only lamps appropriate to the luminaire.
- Light for safety.
- Light for effect. Reduced background lighting levels will create more contrast in a room and save energy.

Controlling lighting

- In private living areas plan for each luminaire to have its own switch so that only those needed have to be on.
- Putting switches in convenient places will encourage switching on and off as often as required. (It is a myth that so much energy is used when a lamp is switched on that it is more efficient to leave lamps lit all the time. However the life of fluorescent lamps can be considerably reduced by very frequent switching.)
- Use dimmers as an energy efficient way of varying lighting. But be sure that the dimmer, the lamp and the ballast if needed, are all compatible.
- Use automatic controls where appropriate.

Directing light to where it is required

An important principle of energy efficient lighting design is to make the most of any light sources available and directing the light to where it is required. Often a whole room is lit to a bright level or even the whole house is lit and yet a person is working with barely enough light for the task in hand, eg reading, sewing or writing. This is clearly an inefficient use of resources. Similarly outdoors, uncontrolled light emitted upwards is wasteful and also the cause of 'light pollution' which reduces night sky visibility.

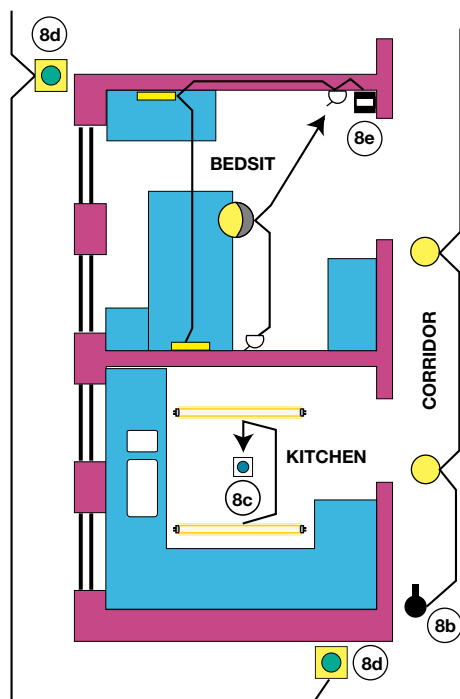
LIGHTING DESIGN

In and around multi-residential buildings lamps are often left switched on in communal areas which are daylit or are unoccupied, so appropriate automatic controls may be well worth while. Photocells (8a) and presence (8b) sensors used independently or combined in one unit (8c) are inexpensive and usually recover their cost within twelve months. Luminaires can be purchased with one or more of these features built in (8d). Key fob or key card switches (8e) are a useful device to ensure that lamps are switched off when private apartments are unoccupied. They can be wired so that removing the key from the holder to lock the door turns off all non essential electrical services one minute after the premises are vacated.

Exterior lighting should be controlled by photocells (8a) or (8d) where possible.

Safety

Safety is always a major consideration and isolation of the automatic controls will be needed for maintenance or repair work. Also when planning automatic lighting control schemes, make certain that potentially dangerous places cannot be plunged into total darkness. If necessary leave some lamps independent of automatic control. Maintained emergency lighting (**maintained illuminance**) could be used for this purpose.



Simple control scheme

Figure 9 shows an example of a simple control scheme suitable for a multi-residential building.

1. The outside lighting to be used during all hours of darkness is by high pressure sodium lamps in wall mounted luminaires switched by inbuilt photocells (8d).
2. The corridor is lit by CFLs switched on by a presence sensor (8b) when someone enters and off shortly after someone leaves (there will also be some uncontrolled lighting in this area). CFLs are capable of standing ten times the switching of tubular fluorescents, but frequent switching will reduce the life of the lamp. If frequent switching is likely, it might be appropriate to consider alternatives eg GLS (refer to manufacturer's guidance).
3. The kitchen is lit by T8 group 1B lamps on soft-start ballasts switched on by presence/daylight sensor (8c). The lights are switched on by someone entering the room when daylight is insufficient and switched off after the last person leaves or by photocell when daylight is adequate.
4. The bedsit area is lit by CFLs. Placing the key fob in its holder (8e) enables the desk and bed head lamps to be switched locally and the centre light by two-way switches located by the door and bed head. When the key fob is removed from its holder on leaving the room, all the lighting is isolated from the supply shortly afterwards and the door locked.

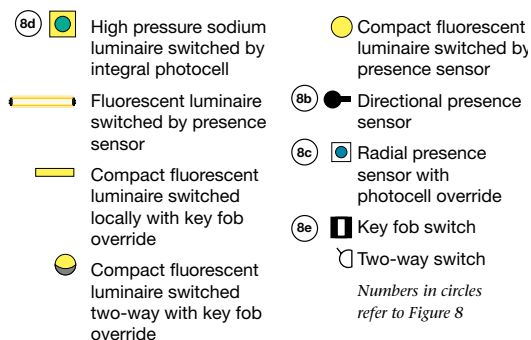


Figure 9 Typical use of lighting controls in a multi-residential building



Figure 8a
Photocell



Figure 8b
Presence
sensor



Figure 8c
Combined
photocell
and presence
sensor



Figure 8d
Luminaire
with
photocell
built-in



Figure 8e
Key fob
switch

LIGHTING DESIGN

Dimming

Dimmers allow the mood of the lighting to be changed easily. Dimmed to 25% of its full light output, a lamp or the lit scene is likely to appear to be about half as bright. When dimmed to 10% of its full light output a lamp or the lit scene will appear to be about a third as bright, due to **adaptation**. There may also be a noticeable change in the colour appearance of the light from a tungsten lamp to a warmer tone but light from fluorescent lamps will appear unchanged.

A dimmer must only be used with the type of lamp for which it is designed and must match the lamp, its ballast or transformer and load current.

Do not attempt to dim fluorescent lamps using a dimmer designed for tungsten lamps. It is essential to choose a dimmer designed for fluorescent lamps and to use compatible special dimmable lamp ballasts which will achieve the level of dimming required.

Filament lamps, including tungsten halogen lamps, are easy to dim and modern domestic phase cut dimmers do save energy. For example, a tungsten filament lamp dimmed to half power (watts) will save about 40% energy and the lamp life will be extended by up to 20 times. However, the lamp efficacy (lumens per watt) of the tungsten filament lamp will be reduced to half.

Some transformers for extra low voltage lamps may not be compatible with domestic phase cut dimmers and the best advice is to check with the manufacturers of both items. Toroidal wound chokes may require a soft-start type of dimmer in which the lamp is always switched on in a dimmed state. Some transformers may be unsuitable and/or cause electromagnetic interference when used with modern domestic phase cut dimmers.

Laminated, open choke wire wound types and many electronic transformers are most likely to be suitable for use with modern phase cut dimmers.

Most four-pin tubular and compact fluorescent lamps can be dimmed, but it is not always possible to dim smoothly down to near extinction. Some may only dim to 25%, others to 15%, 10%, or 5% of full light output. With electronic high frequency dimming, regulating, or variable output ballasts the percentage energy savings roughly equates to the percentage reduction in light output over most of the dimming range.

Two-pin fluorescent lamps including CFLs which fit directly or via an adapter into a standard BC or ES lamp-holder cannot be dimmed.

High pressure sodium SON/E and SON/T lamps are not dimmable.

GLOSSARY

Adaptation. The process which takes place as vision adjusts to the brightness or the colour of the visual field.

Average lamp life. The time when half the number of lamps in a batch under test conditions failed.

Ballast. Also called control gear. Apparatus to start and control the current through the lamp.

Choke. Inductive ballast.

Connected load. The total load connected to the mains including lamp and ballast.

Diffuser. A translucent screen used to shield a light source and at the same time soften the light output and distribute it evenly.

Discharge lamp. A lamp whose illumination is produced by an electric discharge through a gas, a metal vapour or a mixture of gases and vapours.

Efficacy (luminous efficacy). The ratio of luminous flux emitted by a lamp to the power consumed by it, eg lumens per watt. When the control gear losses are included it is expressed as lumens per circuit watt.

Extra low voltage (ELV). Refers to anything under 50V and generally considered harmless. Electrical engineers term 'mains' voltage as low voltage (50V –1000V) because they are used to dealing with voltage levels of 1000V and above. (There is a further category, Safety Extra Low Voltage (SELV) which refers to supplies also under 50V but supplied through an isolating transformer.)

General lighting. Lighting of a whole area.

High frequency electronic ballasts (also called high frequency control gear). Uses solid state technology to run the lamp between 20 to 40 kHz.

Illuminance. The amount of light falling on a surface of unit area. The unit of illuminance is the lux, equal to one lumen per square metre.

Light output ratio. The ratio of the total amount of light output of a luminaire, under stated practical conditions, to that of the lamp.

Lumen. Unit of luminous flux, used to describe the amount of light given by a lamp or falling onto a surface.

Luminaire (light fitting). The correct term for a light fitting. An apparatus which controls the light from a lamp and includes all components for fixing, protecting the lamps and connecting them to the supply.

Maintained illuminance. The average illuminance over the reference surface at the time maintenance has to be carried out by replacing lamps and/or cleaning luminaires and room surfaces.

Power factor. The ratio watts to volt-amps. It indicates the efficiency with which power supplied by the generating station is used. The higher the power factor the better, 1 (unity) being the maximum.

FURTHER INFORMATION

General information

The Electrical Contractors' Association
ESCA House, 34 Palace Court, London W2 4HY.
Tel 0171 229 1266. Fax 0171 221 7344

The Electrical Contractors' Association of Scotland
Bush House, Bush Estate, Midlothian EH26 0SB.
Tel 0131 445 5577. Fax 0131 445 5548

The Electricity Association
30 Millbank, London SW1P 4RD.
Tel 0171 344 5709. Fax. 0171 344 5957

For independent, informed advice about saving energy, contact your local

Energy Advice Centre
Tel (lo-call) 0345 868686

Communal Lighting Improvements Programme.

The Energy Saving Trust
11-12 Buckingham Gate, London SW1E 6LB.
Tel 0171 931 8401. Fax 0171 931 8548

Publications

The Chartered Institution of Building
Services Engineers

Delta House, 222 Balham High Road,
London SW12 9BS.

Tel 0181 675 5211. Fax 0181 675 5449

Publishes various guides and technical memoranda on lighting including 'The Code for Interior Lighting'.

The Institution of Lighting Engineers
Lenox House, 9 Lawford Road, Rugby CV21 2DZ.
Tel 01788 540145. Fax 01788 540145

'Guide to the use of compact fluorescent lamps'.

The Lighting Association
Stafford Park 7, Telford, Shropshire TF3 3BQ.
Tel 01952 290905. Fax 01952 290906
'Buyers Guide'.

The Lighting Industry Federation
Swan House, 207 Balham High Road,
London SW17 7BQ.
Tel 0181 675 5432. Fax 0181 673 5880

A range of publications about lighting applications and equipment including 'The Energy Manager's Lighting Handbook'.

DOE ENERGY EFFICIENCY BEST PRACTICE PROGRAMME DOCUMENTS

Department of the Environment. Converting to compact fluorescent lighting – a refurbishment guide (GPG 159), DOE, London, 1995.

Energy Research Group. Energy efficient lighting in buildings (THERMIE Maxibrochure), ERG, Dublin, 1993.

Energy Research Group. Daylighting in buildings (THERMIE Maxibrochure), ERG, Dublin, 1994.

Department of the Environment. Energy management and good lighting practices (Fuel Efficiency Booklet 12), DOE, London, 1994.

Energy Efficiency Best Practice in Housing

Tel: 0845 120 7799
www.est.org.uk/bestpractice

Energy Efficiency Best Practice in Housing is managed by the Energy Saving Trust on behalf of the Government. The technical information was produced by BRE.

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